Occupancy, Rate Effects & Combinatorial Background

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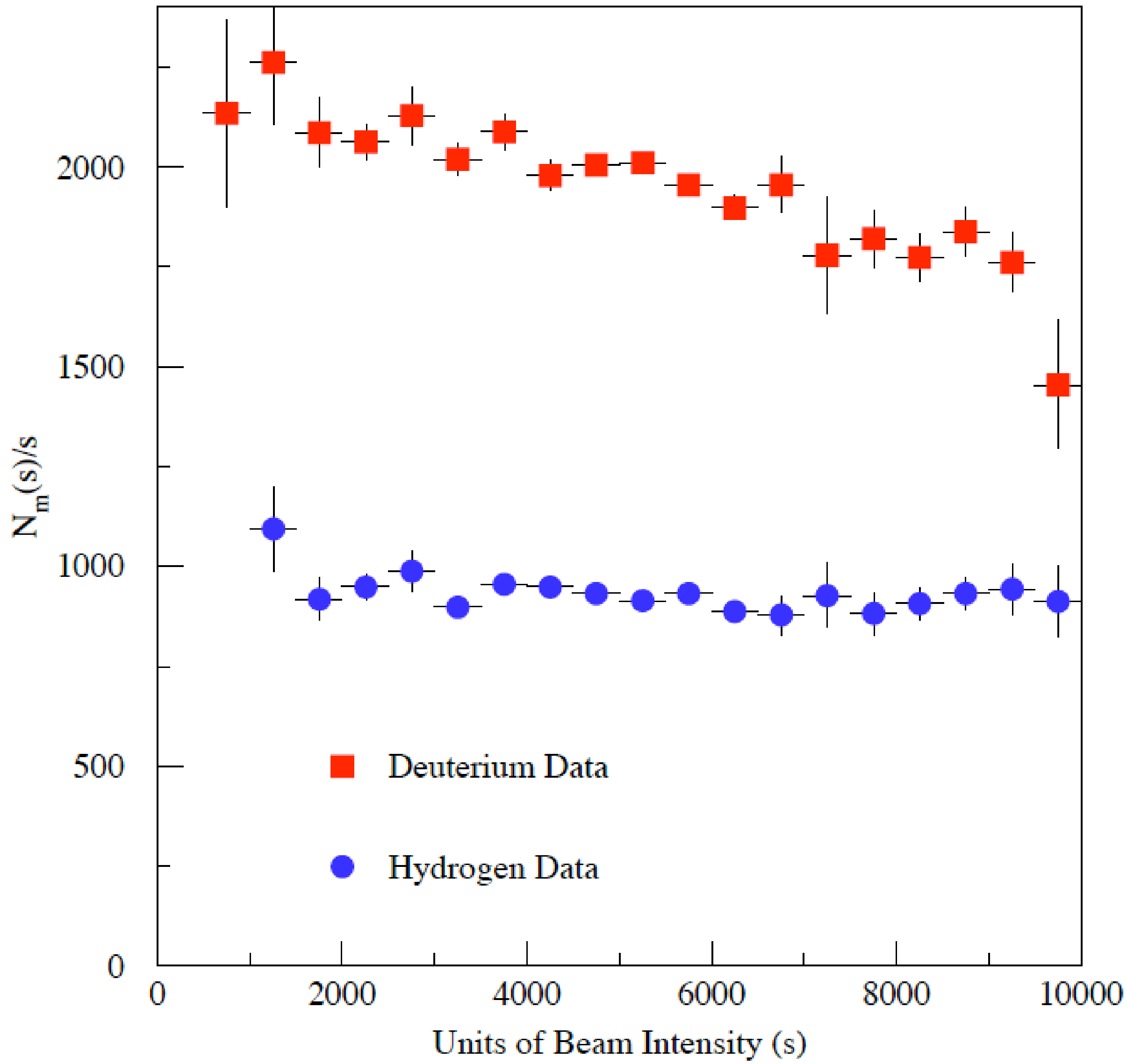
Example of Rate Dependence in the E866 low mass data

$$N_m(s) = N_t(s) \times e(s)$$



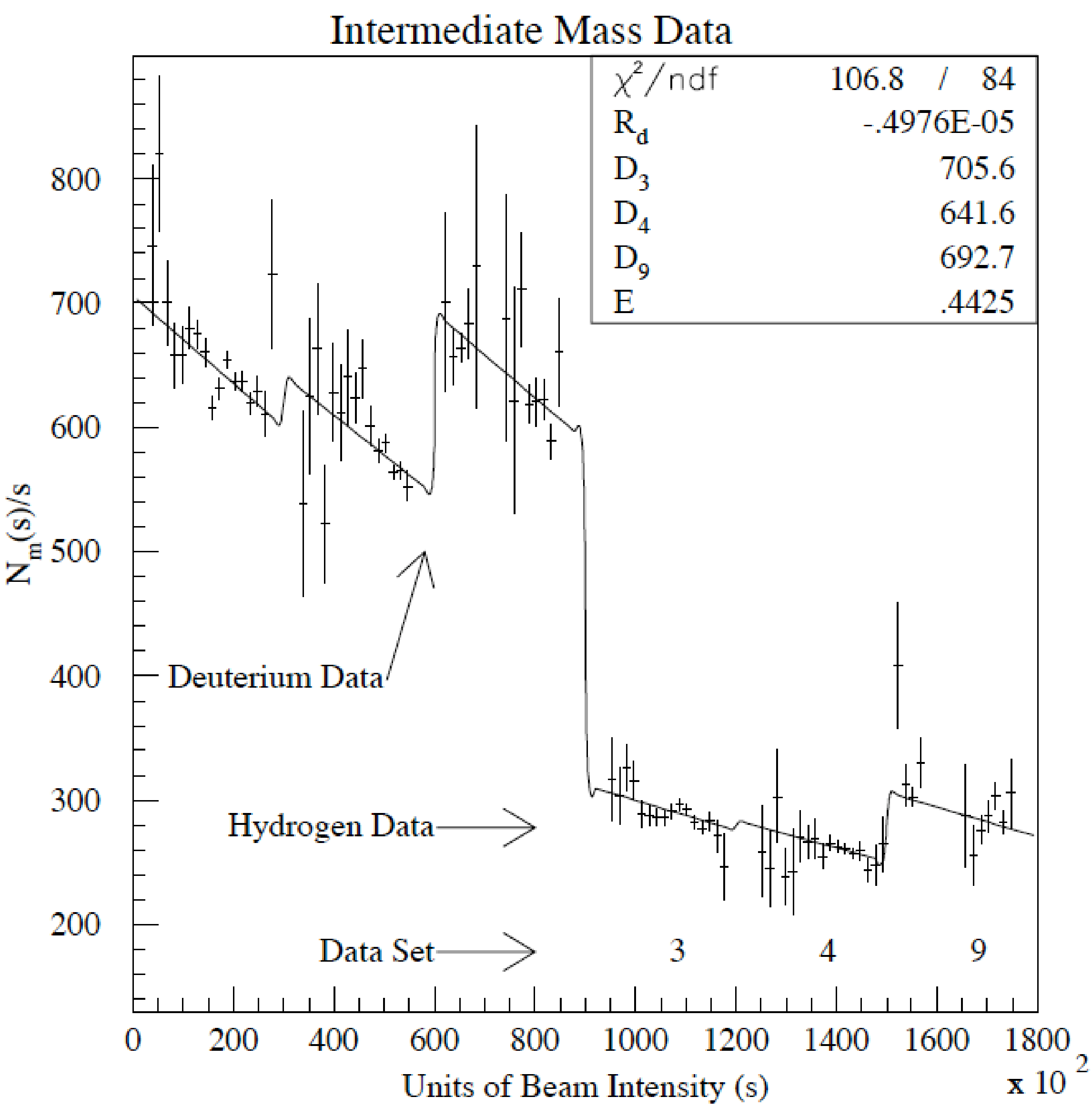
Partial list of rate studies …

- Functional form of the rate dependence.
  - **Linear with beam intensity.**
- Kinematical dependence of the rate dependence (pT, X2, Xf, mass).
  - **none**
- Study of rate dependence in both data and MC of J/Ψ, Drell-Yan, and Υ events.
  - **consistent**
- Occupancy

Occupancy

- Affects event reconstruction (track bank overflow), but if the event reconstructed it had little other impact.
  - Ntuple cut (12*nhodfir+nevlen < 1400)
- Was carefully studied in the data and reproduced in the MC to study the rate dependence. Details included:
  - 2-d distribution of noise hits in detectors
  - correlations between planes in a station
  - correlations between stations
  - multiplicity
  - detector efficiency
- Conclusion of this study showed **Rate dependence was effected most by hits in station 3 > station 2 > station 1 (~ 4:2:1)**

Rate Dependence Correction



- Each data set fit with a linear function.
- Hydrogen slope related to deuterium slope based on occupancy studies. (F = Rd/Rh)
- LD2 events weighted by:

$$\frac{1}{e_d(s)} = \frac{1}{1 + R_d s}$$

Final Rate Corrections

mass setting	percent correction to $\sigma^{pd}/2\sigma^{pp}$
low	$5.45\% \pm 0.82\%$
intermediate	$1.06\% \pm 0.89\%$
high	$1.76\% \pm 0.69\%$

Systematic Uncertainties from 866

source of uncertainty	uncertainty in mass setting high	intermediate	low
rate dependence	0.69 %	0.89 %	0.82 %
target length	0.2 %	0.2 %	0.2 %
beam intensity	0.1 %	0.1 %	0.1 %
attenuation/acceptance	0.2 %	0.2 %	0.2 %
deuterium composition	0.61 %	—	—

- "Total systematic uncertainty is < 1%"

Gas analyses from 866

material	target sample	storage sample
D_2	$93.8\% \pm 0.7\%$	$92.7\% \pm 0.8\%$
HD	$5.80\% \pm 0.58\%$	$6.89\% \pm 0.69\%$
H_2	$0.053\% \pm 0.011\%$	$0.147\% \pm 0.015\%$
N_2	$0.327\% \pm 0.033\%$	$0.245\% \pm 0.024\%$
Ar	$0.003\% \pm 0.002\%$	—
CO_2	$0.006\% \pm 0.003\%$	$0.0039\% \pm 0.0008\%$

Combinatorial Background

a.k.a. Randoms

- To correct for these, requires 2 special triggers:
  - Single muons
  - Like sign muon pairs
- Singles are analyzed just like individual tracks in a good dimuon event and then combined to form randoms.
- The randoms are compared with the like sign muon events to ensure proper kinematics and normalized before they are subtracted from good events.
- For E866 much of this work was done by Maxim from Texas A&M.
- Randoms corrections for ‘low mass’ data set was about 4.4% with some data points about twice that.

Suggestions

- Use equal interactions length targets with their average interaction points aligned.
- Take more data.
- Consider special ‘high’ and ‘low’ luminosity runs???
- Take equal amounts of events on both targets (ld2 and lh2) not equal luminosity?

Resources

- Rate notes:
  - http://p25ext.lanl.gov/e866/protect/udhi/rate.ps
  - http://p25ext.lanl.gov/e866/protect/udhi/gtg.ps
  - http://p25ext.lanl.gov/e866/protect/ud/f.ps
- My dissertation
  - http://p25ext.lanl.gov/e866/protect/thesis/thesis.html